SCIENCE AND AGRICULTURE.

A POST WAR OPPORTUNITY FOR THE DEVELOPMENT OF THE AGRICULTURAL RESOURCES OF W.A.

PRESIDENTIAL ADDRESS

BY

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On this, the occasion of the last phase of my activity as President of your Society, I desire to thank the members and particularly my colleagues on the Council for the loyal and hearty support which they have afforded me during the past year, and which has rendered my duties so pleasant.

Though my remarks, regarding the opportunity which presents itself to Western Australia because of the world shortage of foodstuffs, apply to Agriculture generally, yet following a recognised custom I have more particularly dealt with that branch of Agriculture, viz., wheat growing with which I am working and am therefore more familiar.

In his presidential address to the British Association for the Advancement of Science, Sir Wm. Crookes in 1898, startled the civilised world by pointing out that the consumers of wheat were in crescendo progression and by forecasting that, as the world's available wheat lands were known, the consumption of wheat would overtake the supply by 1931, and unless the world's average yield could be increased, principally by the adoption of a system ensuring the more liberal application of nitrogenous manures, the visible supply of which was also within sight of exhaustion. The prediction was made upon the most reliable data then available, but Science ever ready to respond to the stimulus of need, has extended the date when the event anticipated by Sir Wm. Crookes would have occurred under normal conditions. In making his estimate, Australia as a wheat producing country was regarded as a negligible factor because of its uncertain seasons. In this connection the wheat production of the States other than South Australia was regarded as so uncertain "as to cause Europeans to wonder why the pursuit of wheat growing is continued."

Though the seasons are not more regular and droughts still occur, the wheat crop is not nearly as uncertain as formerly and

once only during the past ten years has the Australian crop been insufficient for local needs. Even in that season 1914-15 of exceptional drought, over 650,000 tons were produced and in the succeeding year, consequent upon a special effort to meet the war needs of the Empire, combined with a satisfactory rainfall, a record yield of nearly four and three-quarter million tons was produced. Despite its climatic uncertainties, the volume of wheat produced in Australia has so increased that its production is now an important factor in the world's trade to the extent of some one and a-quarter million tons annually. This has been brought about largely as the result of the scientific production of new and more suitable varieties of wheat and the adoption of sound scientific methods of manuring and tillage.

Nor need the exhaustion of the world's supply of nitrogenous manures any longer be feared. This is also due to scientific discoveries by means of which the illimitable free atmospheric nitrogen can be fixed and made available for our needs. The supply of nitrogen from this source is now available commercially as "Nitrolin" and kindred manures, and in these the world has received from Science a gift of inexhaustible extent.

Though the permanent shortage of wheat as feared by Sir Wm. Crookes has been postponed indefinitely, yet the civilised world has temporarily reached the position forecasted by him. To-day there is not enough wheat in the world to meet its needs. This position is the natural corrollary of the great war which has caused the absolute depletion of the world's supply and reserves of wheat. This shortage of wheat has also created an unusual demand for other foodstuffs in lieu thereof, until at present there is in Europe such a general shortage of foodstuffs as has never before been experienced. The extent of the shortage of all foodstuffs can be best illustrated by the position with regard to wheat, as this is the most important article of foodstuffs dealt with in international trade, and in that connection it is also the foodstuff of greatest importance to Western Australia. It is quite true that four years of the most devastating war the world has ever known, have thrown all cereal statistics into the melting pot, yet a very good idea of the position can be obtained by studying the statistics for the quinquennial period preceding the war—and this despite the fact that during the war some wheat producing countries harvested abnormally large crops. This was offset by the fact that in other countries there were total or partial failures. In a bulletin, "The World's Supply of Wheat and other Cereals," published by the International Institute of Agriculture (March, 1915), Sir James Wilson shows that the world's average annual production of wheat for five years (1909–1913) preceding the war was 1,059,200,000 quintals (104,000,000 tons) and of this amount the principal belligerent nations engaged at the commencement of the war produced 484,400,000 quintals (47·6 million tons). Details of this production

are set out in the table hereunder, which also shows the net imports and net exports of each country :—

Wheat Production—Imports and Exports of Belligerent Nations.

	Production.	Net Imports. Millions of tons.	Net Exports.
Germany	4·07	1·83	...
Austria	1·63	·28	...
Hungary	4·54		
Belgium	·39	1·32	...
France	8·49	1·17	...
Bulgaria	1·22	...	·28
Great Britain	1·59	5·77	...
Greece	·12	...	...
Italy	4·90	1·42	...
Roumania	2·35	...	1·43
Russia	17·12	...	4·39
Poland	·61	...	...
Serbia	·36	...	...
Turkey	·19	...	...
Total	47·58	11·79	6·10

From these figures it will be seen that in normal peace times the nations then at war required to import over 5½ million tons in order to meet their consumption demands.

Though, throughout the war, each belligerent nation maintained its agricultural productions at the highest possible level compatible with the maintenance of its fighting strength, and Great Britain as the result of splendid organisation actually produced more wheat during the later years of the war than during a similar pre-war period; yet with the enormous number of men under arms and the devastation occurring, especially in France and Belgium, it was impossible that the other belligerent nations should do likewise. Since the conclusion of the war we have learnt definitely that the production has been far indeed below the pre-war level. There was therefore greater need to augment the local supply in the belligerent countries during the war than prior to it. The supplies to the allies from overseas were maintained, but owing to the effective blockade maintained against enemy countries, very little if any went to them. In consequence, the European granary has been found to be bare to the boards and the people in enemy countries are not only hungry, but actually starving for bread.

The position is the more serious in that there are no wheat reserves stored in countries remote from the war to draw upon, for it has been quite impossible to build these up. Using again the figures available for the quinquennial period 1909–1913, it is found

that the average annual quantity of wheat available for export by countries remote from the war was—

Average Export of Exporting Countries, Remote from War, five years 1909–1914.

	Millions of tons.
United States	2·46
Canada	2·18
Argentine	1·91
Australia	1·23
India	1·14
	8·92

Even if their production during the war time had been maintained on a pre-war level, the Allies would have required to import as follows :—

	Millions of tons.
Belgium	1·13
France	1·00
Great Britain	4·98
Italy	1·23
Total	8·34

or 0·6 million tons less than is normally available from exporting countries remote from the scene of war.

Consequent upon the ravages of war and with the greatly decreased production, though of unknown extent, occurring in Belgium, France, and Italy, the imports required to meet their needs during the years of the war period have been obviously much greater, and in consequence the whole of the surplus of wheat exporting countries remote from the scene of conflict has been more than required by the Allies and neutrals, and there are therefore no reserves except those of Russia, a doubtful and unknown quantity.

The unprecedented shortage of foodstuffs in Europe is regarded as one of the fundamental causes of the many difficult post war problems, including industrial unrest with which the world is faced. The great need to-day is therefore the replenishment of the world's food supply.

In common with the other States of the Commonwealth, the world's great need for agricultural produce is the *opportunity* of Western Australia to develop its agricultural resources quickly

and profitably. The unprecedented demand for foodstuffs postulates high rates for all kinds of agricultural produce, and these are likely to be above normal for some years. Not only do the pressing immediate needs require to be met, but those reserves which have been exhausted and which are so economically essential for the welfare of nations, have to be replaced before the European granary can be said to be in a normal condition again.

Our agricultural resources can be developed in the following ways :—

(*a.*) By bringing new lands of recognised agricultural value into cultivation.

(*b.*) By the profitable reclamation and utilisation of areas at present considered unprofitable for agricultural production.

(*c.*) By improvement in our methods so as to increase the production of the land already under cultivation.

The bringing of new lands of recognised agricultural value into cultivation calls only for that business organisation and effort which has been so tremendously successful in settling the wheat lands of the State since the beginning of the century. How successful this has been is shown by the fact that at the beginning of the century the State produced 774,000 bushels of wheat—not sufficient for its own requirements, and in 1915-16 its production was 18,236,000 bushels, and over 14,000,000 more than was required within the State.

As in all other agricultural countries, so in W.A. there are lands which are considered unprofitable for agricultural purposes. This may be because they are—

(*a.*) Of poorer quality than those in general cultivation, or

(*b.*) Located outside what at present are regarded as favourable climatic conditions.

If the agricultural resources of these lands are ever to be developed it must be done by the application of the teachings of Science to the agricultural methods adopted for their cultivation. It may be that the special problems of Western Australia in connection with these lands will require that research work be conducted in order to ascertain the principles underlying them. It is, however, believed that our great need at present, is to take advantage of the research work already done elsewhere and to apply it here. This can only be done by trials or experiments. Experiment Farms are needed therefore to learn how to apply to both types of land the facts and laws already known. The need is particularly great in connection with the development of our light lands. To develop these we need especially to ascertain how the known laws relating to soil improvement can be applied and how to produce fodder and other crops peculiarly adapted for them.

A notable instance of what has been done in connection with the reclamation of land outside of what, at one time, were regarded

as suitable climatic conditions for wheat production, is the extension of the wheat lands of the world as the result of the adoption of " dry farming " methods, in other words the adoption of scientific methods of tillage to conserve moisture. In our own State the wheat belt has been extended in this way to the 10-inch isohyet. The Experiment Farm at Merredin on that line has shown that wheat growing is quite safe there, and Science ever progressing and unable to stand still is now asking whether the line cannot be extended still further eastward.

Already this problem is being attacked in Mesopotamia with an annual rainfall of less than seven inches and with much less relative humidity than in Western Australia. Success hinges upon methods which apply scientific principles to the conservation of soil moisture and the development of early maturing varieties of wheat. We are not less resourceful than our kinsmen who are attacking this problem in Mesopotamia. Our conditions are more favourable, our prospects are therefore brighter. The time is in consequence, opportune for the establishment of an Experiment Farm outside the area in this State are present considered safe for wheat cultivation.

From time immemorial agricultural problems have proved complex and full of pitfalls even for men of the mental calibre of Boyle, Davy, and Liebig. Those now to be dealt with will be equally as complex and as full of pitfalls as when the principles underlying the Science of Agriculture were being established, unless those entrusted with their solution have been trained regarding these principles and have been made familiar with the most recent knowledge of the subject. It is therefore essential that the solution of the agricultural problems confronting us shall be entrusted only to those who have received a sound scientific training in the principles of Agriculture, otherwise misleading deductions are likely to be made and erroneous theories likely to be propounded. Trained men are therefore required to take charge of these Experiment Farms.

Though considerable development of new lands will take place in the future, it is not to be expected that production in the future will bear the same relation to the opening up of new lands as it has done in the past. A considerable acreage of the new lands will be required to replace the older lands and take their place for stock feeding and other purposes in the farm rotations as the pioneering stage passes. As our new lands become settled, more and more each year will increased production depend upon better methods. Just as the application of principles of Science to the practice of Agriculture will enable us to develop the resources of the areas at present considered unprofitable for agricultural production, so the productivity of the lands already under cultivation can be increased also by the more general adoption of such a plan.

There are those who still maintain that successful farming requires only common sense, muscle, and machinery, and that Science applied to the most ancient of arts is still theoretical, and has little to do with the business of life. The number is, however, rapidly diminishing, and the value of Science as applied to Agriculture is receiving general recognition. It is especially valuable in new undeveloped countries like our own without centuries of experience to guide us. Its aid is absolutely essential if new methods are to be on a sound basis. Amongst the many things Science has taught agriculturalists, a few are :—

How to produce new varieties.
How to improve existing varieties of plants.
How to transform dormant manures into quickly acting ones.
How to conserve soil moisture.
How to utilise the inexhaustible supply of atmospheric nitrogen.
How the organic matter of the soil may be increased.
How plants obtain their food from the soil and from the air.
How to combat plant and insect pests.
How to feed stock on economic principles.

As the result of such teachings, the soil can be made to produce prolifically and continuously, unfavourable climatic influences are minimised, and the great losses caused by insect and other pests lessened.

The classical example of the economic benefits resulting from the application of the principles of Science to Agriculture is the increased production which took place in Germany during the 25 years 1888 to 1913, without which it would have been quite impossible for that nation to have continued in the war as long as she did. The increase is shown in the following table :—

Table showing the Production of Farm Produce and Live Stock in Germany in 1888 *and* 1913.

Crops.	1888.	1913.	Increase.	Decrease.
	Millions of bushels.	Millions of bushels.		
Wheat	103	171	68	...
Oats	243	669	426	...
Barley	97	168	71	...
Rye	262	481	219	...
Potatoes	950	1,988	1,038	...
Stock (in thousands)— ...				
Horses	2,420	4,523	2,103	...
Cattle	8,740	20,182	11,442	...
Pigs	5,820	22,100	16,286	...
Sheep	14,750	5,803	...	8,947

*Year Book of U.S.A., Department of Agriculture, 1915.

Assuming that one horse or cow is equivalent to eight sheep, and one pig to one sheep, the total increase of live stock is equivalent to 114,000,000 sheep.

In an article dealing with the recent development of German Agriculture, 1888–1913, Mr. T. H. Middleton, Assistant Secretary to the British Board of Agriculture points out *—

> "It is shown that the area of cultivated land in Germany has slightly decreased in recent years. The reclamation of moorland about which we hear much, is interesting as an indication of agricultural energy, but it counts for little in the feeding of the German people. The agricultural population has remained practically stationary. Rather less, than more labour is being employed now than twenty-five years ago. It is, indeed, evident that the larger production has not been due to an increase in the area tilled, or to an increase in the number of persons engaged in tillage, but to better farming, the soil has been better cultivated, crops have been more skilfully manured, plants and animals have been improved in type, the use of oil cakes and other feeding stuffs has increased, sanitary laws have led to a great improvement in the health of farm live stock. Side by side with these improved technical methods, improved business methods have been resorted to and the profits of agriculture have in turn been employed in further developing the means of production."

From this it will be seen that the remarkable increase in German crop production and live stock farming is not due to increased acreage under crop, nor to greater numbers engaged in Agriculture, but to the increased efficiency of their farming methods. This point is confirmed by a comparison of the average yearly yields of cereals, hay, and potatoes during two quinquennial periods occurring in a period of twenty-five years.

Table showing yearly average Yield per Acre of Cereals, Hay and Potatoes in Germany during a Period of 25 *Years* :—

	Yield per Acre per Annum	
	1888–1889	1903–1913
Wheat, bushels	19·8	31·6
Barley ,, ...	22·7	36·7
Oats ,, ...	25·7	44·6
Meadow Hay, cwt.	22·5	33·7
Potatoes, tons	3·4	5·4

Such remarkable results are illuminating and should be inspiring. They are sufficient to warrant that nothing shall be

*Journal of the Board of Agriculture, 1916.

left undone to bring about more general adoption of the latest scientific teaching to the practice of Agriculture.

Consequent upon the number of the world's agricultural workers, scientific progress in Agriculture has never been as rapid at any period as at present, and it is believed that if the most advanced methods were generally adopted by the majority of our farmers, our production per acre would increase at least fifty per cent.

A local writer has recently stated: "Rapid progression in the application of scientific discovery to practical purposes is now a world wide rule." Unless, therefore, steps are taken to ensure that the scientific discoveries made in connection with agricultural science are promptly applied to agricultural practice then agriculture lags behind the other arts in their up-to-date plan of taking advantage of scientific discoveries.

The general adoption of the latest scientific teaching to the practice of Agriculture, and the resultant increase in the agricultural output of the State, can best be brought about by a scheme of agricultural education, for as one writer states:—

> "The man power is the real measure of efficiency in production, rather than acre yields, and the increase in this efficiency rests upon the spread of education. To raise the scale of production, there must be a higher level of education among the mass of farmers to bring up those below the average, and to raise the average up to the better ones."

The scheme of agricultural education adopted should provide for—

(*a.*) The training of young people in the scientific principles underlying the practice of Agriculture.

(*d.*) The dissemination of agricultural information amongst adults.

The scheme of Agricultural Education in this State is on an excellent basis, but requires elaboration and extension. It commences in the primary schools and continues with its apex at the University. In the rural primary schools it is very properly limited, so that it is unspecialised, and it is utilised in as far as it, as a Science, can be applied to the general education of the pupil. It is of special interest and value in these schools because of its association with the environment of the scholars. Elementary Agricultural Science is also taught in the District High Schools, in some Secondary Schools and at the Narrogin School of Agriculture. From these schools the student can proceed to the more advanced scientific training at the University.

At the Narrogin School of Agriculture practical tuition in the art of farming is given in addition to the training in Agricultural Science. It is the only specialised institution of its kind in the State. It is a junior institution with a two years' course, and

has a total accommodation for forty students whose ages range from 14 to 18. The facilities available are totally inadequate to the needs of this State, containing as it does some 8,000 wheat growers in addition to fruit growers, and other farmers. It is at this specialised stage that our system of agricultural education is weakest. The School of Agriculture at Narrogin has already done excellent work. Its accommodation requires enlarging and its equipment improving. In addition, provision for a senior or diploma course requires to be made at an associated but senior institution for it is the specialised courses, junior and senior, which have for their object the training of educated practical farmers. The Professor of Agriculture, in order to meet the needs in this connection has done what was possible and has established a diploma course at the University. The disadvantage of this is that it is non-residential. The University provides a degree course in Agricultural Science and it is this course which provides for the training of research workers, agricultural teachers, and agricultural advisers and field officers of the future. The course is sufficient for this purpose if utilised. A similar course is provided in most of the other State Universities, but enrolment has always been small. This condition is attributed to the restricted field now open to University Graduates in Agriculture.

In addition to providing the useful graduate course it is believed that the University can with advantage to the State, take a special interest in its agricultural problems and that after the requirements of a full and broad general education are satisfied, the general activities of the University can well centre around the Chair of Agriculture because of the relation which it should bear to, and the connection it should have with, one of our principal primary industries. The growth of plants has interested the thinking men of all ages. Is it too much to expect that the scientists at the University specially interested in our local problems shall take special interest in this matter now that the problem is one of vital economic importance not only to the State, but also to the Empire ?

The dissemination of agricultural information amongst farmers is carried out by means of peripatetic lectures and demonstrations by specialists of the Department of Agriculture, by University extension lectures, and by the free distribution of bulletins relating to agricultural matters of topical interest. The need of this phase of agricultural education is great in any new country, but it is greater in this State where the ranks of agriculturalists are recruited from all sections of the community and not principally from those with a previous connection with the land. How great is the need for the dissemination of up-to-date agricultural information, may be gauged from the fact that the deficiencies of the original theories of Liebig and others regarding soil and plant analyses are still extant.

The work of spreading the latest information amongst farmers, and thus providing facilities for maintaining their technique at the highest possible level, will call for an increasing number of skilled specialists, preferably of university rank. The need of the present is, and the greater need of the future will be therefore, scientifically trained men. They are required as reachers of Agricultural Science, Officers of Experiment Farms, Field Officers, and Inspectors in order that the fullest development of our agricultural resources may take place as the result of the application of the principles of Science to the practice of Agriculture. The trained men necessary can be turned out by most of the Australian Universities, which have been offering courses in Agriculture for several years past. The enrolment has always been small, largely because of the restricted field now open to University Graduates in Agriculture. Because of the usefulness of these Graduates to the State, the field should be widened, and it is not unreasonable to assume that this State which has made such a huge success of settling its lands, will also make satisfactory provision for training the necessary men when it realises how necessary they are in order to develop the settled lands.

Thanks very largely to the foresight of the late Sir Winthrop Hackett, by whom the Chair of Agriculture was endowed at the West Australian University, the facilities for training the men required are available in this State. Unfortunately, great as is our need, the fullest advantage is not being taken of them. This will only be done when the State, which properly controls the needed experimental work, undertakes to train the officers required. The State of New South Wales has found it advantageous to adopt this course and has established a system of cadetships, by which some of its officers have been and others are to be trained. Victoria is adopting a similar course and has undertaken to find positions at remunerative salaries for six graduates in Agricultural Science each year during the next five years.

If West Australia is not to lag behind in the race for agricultural development, it is imperative that she should adopt a similar course. With greater interests than other states in rural activities requiring Agricultural Advisers and Land, Bank, and other Agricultural Inspectors, the need in this State for trained men is greater. It is believed that the most suitable method is to establish a system of cadetship which will provide for training yearly in the Diploma or Degree Course of at least five men who would become available for new positions such as Experiment Farm Officers, Plant Breeders, and Agricultural Advisers, and to fill vacancies as they occur in the ranks of Land, Bank, and other Inspectors.

The benefits of applying the principles of Science to the practice of Agricultural are tangible and real. They are not always appreciated. The value of such a plan following upon the result of a well organised system of Agricultural Education is illustrated by

the German experience when their crop production was increased by £120,000,000 in twenty-five years and the value of the live stock was increased from £320,000,000 in 1892 to £660,000,000 in 1914. Professor Von Rumken, of Berlin, thus summaries the German view of Agricultural Education—

> "The great progress that Agriculture has achieved in Germany during the last quarter of a century is the result of the Union of *Practice* with *Science* and proves that money spent on reasearch and on education in every class brings in a huge rate of interest and is compensated for by increase in land taxes and of revenue from State Railways."

Not only is there a strong material advantage to be gained by the development of our agricultural resources, there is in addition a strong moral obligation to develop the wheat lands of this State. With the number of wheat eaters throughout the world gradually but persistently increasing, the available harvest fields are by no means too extensive for its needs. Not to develop our harvest field, small comparatively though it is, is to shirk our responsibilities. This is especially so as the wheat produced under our climatic conditions is of exceptionally fine quality. As one writer (Hugh R. Rathbone, Staple Trades of the Empire), says of Australia, "It is perhaps the finest wheat in the world and from the point of view of consumption has only one drawback—the long voyage." British millers find Australian wheat valuable for improving the keeping qualities of their own locally grown wheat. It is also useful for imparting colour and bloom to the flour made from British wheat. There are therefore International and Imperial reasons as well as a material and selfish one for the speedy development and extension of the wheat lands of Western Australia.

From time to time more or less well informed visitors have taunted Australians because of the frequent use made of the word potentialities. Because of the low esteem in which Australia and its products were formerly held, Australians in the past were compelled to draw attention to the immense dormant wealth of our continent by talking about it. Since the war the world has had reason to believe in our potentialities. It is necessary therefore no longer to talk about them; it has become our duty to develop them. The need for developing our agricultural resources is urgent and the scientist is called upon to co-operate with the agriculturalist in a joint effort. The need for this co-operation was recognised by the late King Edward, who at the opening of the buildings of the University of Leeds in 1908 thus expressed himself—

> "It is a source of pleasure to me to know that you have provided also for the study of the theory and practice of Agriculture, for I am convinced that the best possible results cannot be derived from the industry and natural ability of our farmers unless they are properly instructed in the scientific aspects of their work."